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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/589,852	11/27/2006	Noboru Ichinose	PHKF-05004US	3677

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EXAMINER	
WHALEN, DANIEL B	
ART UNIT	PAPER NUMBER
2829	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/589,852	ICHINOSE ET AL.	
	Examiner	Art Unit	
	DANIEL WHALEN	2829	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 January 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4,5 and 8-21* is/are pending in the application.

4a) Of the above claim(s) *9-15* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4,5,8 and 16-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to an amendment after non-final rejection filed on 10/30/2007. Claims 2-3 and 6-7 are cancelled and claims 9-21 are added by applicant.

1. Newly submitted **claims 9-13** directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: The original claims were directed toward the manipulation of the conductivity of the Ga_2O_3 single crystal system, while claims 9-13 are directed only towards the growth of β-Ga_2O_3 polycrystalline system.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claims 9-13 have been withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

2. Newly submitted **claims 14-15** are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: The original claims were directed toward a method of manipulating the conductivity of the Ga_2O_3 single crystal system, while claims 14-15 are directed toward a light emitting element.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for

prosecution on the merits. Accordingly, claims 14-15 have been withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. **Claims 16-18** are rejected under 35 U.S.C. 102(b) as being anticipated by Harwig et al. ("Electrical Properties of β-Ga_2O_3 Single Crystals. II,"; hereinafter "Harwing").

5. **Regarding Claim 16**, Harwig teaches a method of controlling a conductivity of a Ga203 system single crystal, comprising:

adding (doping) a predetermined dopant to the Ga_2O_3 system single crystal (β-Ga_2O_3 single crystal) to obtain a desired resistivity (page 205, introduction line 1-15, experimental line 1-13),

wherein said predetermined dopant comprises a p-type dopant (Mg; also applies to **claim 17** for p-type dopant) for increasing a resistance of the Ga_2O_3 system single crystal, said p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Mg, Ca, Sr,

Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, T1, and Pb (page 205, introduction line 1-15, experimental line 1-13).

It is noted that conductivity is simply the reciprocal of its resistivity. Therefore, decreasing conductivity of the Ga_2O_3 system single crystal is increasing resistivity of the Ga_2O_3 system single crystal.

6. **Regarding Claim 18**, Harwig teaches that said n-type dopant (Zr) comprises one of Si, Hf, Ge, Sn, Ti, and Zr.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. **Claim 1, 4, and 5** are rejected under 35 U.S.C. 103(a) as being unpatentable over Harwig in view of Ueda et al. ("Synthesis and control of conductivity of ultraviolet transmitting β-Ga_2O_3 Single Crystal"; hereinafter "Ueda").

9. **Regarding Claim 1**, Harwig teaches a method of controlling a conductivity of a Ga_2O_3 system single crystal, comprising:

adding a predetermined dopant to the Ga_2O_3 system single crystal to obtain a desired resistivity (page 205, introduction line 1-15, experimental line 1-13),

wherein said predetermined dopant comprises one of:

a n-type dopant (Zr) for decreasing a resistance of the Ga_2O_3 system single crystal; and

a p-type dopant (Mg) for increasing a resistance of the Ga_2O_3 system single crystal.

However, Harwig does not disclose that the predetermined dopant comprises one of: the n-type dopant comprising one of Si, Hf, Ge, Sn, and Ti; and the p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Ca, Sr, Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, Tl, and Pb. Ueda discloses adding the dopants such as Sn to the Ga_2O_3 single crystal to control the conductivity (page 1361). Therefore, it would have been obvious to one of the ordinary skill in the art at the time of the invention to combine the teaching of Harwig with that of Ueda as the dopant such as Sn is readily available n-type dopant to the Ga_2O_3 single crystal.

It is noted that conductivity is simply the reciprocal of its resistivity. Therefore, decreasing conductivity of the Ga_2O_3 system single crystal by adding the p-type dopant is increasing resistivity of the Ga_2O_3 system single crystal. Also, increasing conductivity of the Ga_2O_3 system single crystal by adding the n-type dopant is decreasing resistivity of the Ga_2O_3 system single crystal.

Regarding Claim 4 and 5, teaching of Harwig and Ueda has been discussed above. However, the combined teaching is silent as to describing numerical values of the resistivity and a carrier concentration. It is noted that the combined teaching teaches an identical process, such as doping a predetermined dopant to the Ga_2O_3 system single crystal, and an identical material, such as n-type dopant and the p-type dopant. Therefore, a value of 2.0 X 10^{-3} to 8.0 X 10^{2} Ωcm as the desired resistivity by adding the n-type dopant and a carrier concentration within a range of 5.5 × 10^{15} to 2.0 X $I0^{19}$ Ωcm are obtained. MPEP 2112.01.

Furthermore, applicant should note that it has held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Harwig as applied to claim 1 above, and further in view of Tamura et al. (US Pub 2004/0113156 A1; hereinafter "Tamura"). Teaching of Harwig has been discussed above. However, Harwig does not disclose the numerical value of the resistivity for adding p-type dopant. Toyama discloses adding the p-type dopant such as zinc to Ga_2O_3 single crystal (page 7, paragraph 98-99). Therefore, it would have been obvious to one of the ordinary skill in the art at the time of the invention to combine the teaching of Harwig with that of Tamura as the dopant such as Zn is readily available n-type dopant to the Ga_2O_3 single crystal to obtain 1 X 10^{3} Ωcm or more as the desired resistivity. Furthermore, applicant should note that it has held that discovering an optimum value of a result effective

variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

10. **Regarding Claim 19-21**, Teaching of Harwig has been discussed above. However, Harwig is silent as to describing numerical values of the resistivity and a carrier concentration. It is noted that Harwing teaches an identical process, such as doping a predetermined dopant to the Ga_2O_3 system single crystal, and an identical material, such as n-type dopant and the p-type dopant. Therefore, a value of 2.0×10^{-3} to 8.0×10^{2} Ωcm as the desired resistivity by adding the n-type dopant, a carrier concentration within a range of 5.5×10^{15} to 2.0 X $I0^{19}$ Ωcm, and 1×10^{3} Ωcm or more as the desired resistivity for adding p-type dopant are obtained. MPEP 2112.01.

Furthermore, applicant should note that it has held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Response to Arguments

11. Applicant's arguments with respect to claim 1, 4-5, 8, and 16-21 have been considered but are moot in view of the new ground(s) of rejection. The rejections to the invention set forth in claims are discussed above.

Conclusion

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DANIEL WHALEN whose telephone number is (571)270-3418. The examiner can normally be reached on Monday-Friday, 7:30am to 5:00pm, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ha Nguyen can be reached on (571) 272-1678. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/D. W./
Examiner, Art Unit 2829

Daniel Whalen

/Ha T. Nguyen/

Supervisory Patent Examiner, Art Unit 2829